
A Technique for Standardizing the Jet Injector and Mantoux Tuberculin Skin Tests

WILLIAM C. BAILEY, MD, DORIS H. THOMPSON, MD, MPH,
and HARRY B. GREENBERG, MD

CRITICS of the jet-injector gun method of tuberculin skin testing have emphasized the method's lack of sensitivity. Feigenbaum and co-workers (1) cited a high percentage of false negative responses to jet-injected tuberculin among South Vietnamese mental patients. In a study of Georgia school children, Luby (2) and Dull and associates (3) also noted a significant number of false negative responses to jet-injected tuberculin. They reported that on the average, only 53 percent of the tuberculin ejected by the jet gun penetrated skin.

When the U.S. Armed Forces' jet-injector gun was adapted for intradermal injection, the nurses at the New Orleans Tuberculosis Clinic began to use it for skin testing (4). They found, as had others (1,2) who questioned its reliability, that tuberculin testing with the jet gun was fast. (An experienced nurse can give tuberculin tests to about 400 children per hour with the jet-injector gun.) They also found that a jet-ejected dose of 0.1 ml of tuberculin made a smaller intradermal wheal than the same dose of tuberculin injected by syringe and needle (Mantoux test). As a result, we increased the dosage of tuberculin ejected by the jet gun to 0.14 ml, which produced

intradermal wheals comparable in diameter with those of the Mantoux test. Then we studied the reliability of jet-ejected tuberculin in dosages of 0.14 ml in provoking responses as compared with syringe and needle injected tuberculin (Mantoux test) in dosages of 0.1 ml.

Study Methods

The study population comprised 522 pregnant women (ages 15-40 years chosen seriatim during a 3-month period) whose need for tuberculosis

Dr. Bailey, formerly director, New Orleans Tuberculosis Clinic, and assistant professor of medicine at the Tulane University School of Medicine, New Orleans, is now at the University of Alabama Department of Medicine, Birmingham; Dr. Thompson is director, New Orleans Health Department; and Dr. Greenberg is a clinician at the New Orleans Health Department and clinical associate professor of medicine, Tulane University School of Medicine. Tearsheet requests to Harry B. Greenberg, MD, 3600 Prytania St., New Orleans, La. 70115.

control measures was being studied (4) while they attended the Family Planning Clinic in New Orleans.

Two experienced nurses from the New Orleans Health Department gave the tuberculin tests and kept records on each woman and her responses. The nurses were assisted by a public health adviser, who was familiar with jet-injector apparatus, and personnel from the Family Planning Clinic.

The Tuberculosis Program, Center for Disease Control in Atlanta, Ga., supplied the purified protein derivative tuberculin (PPD-T) in a concentration of 5 TU (0.0001) per ml. The nurses used a B-D Plastipak disposable tuberculin syringe with needle for each Mantoux test. For each jet-injected test, they used a commercially available, portable jet-injector gun fitted with an intradermal nozzle.

We tested the jet-injector gun to find the dosage of tuberculin needed to produce an intradermal wheal of 8 mm in longest diameter. (The 8-mm diameter was chosen because it corresponded with that of the Mantoux test.) We found that our jet-injector gun consistently produced satisfactory wheals without further adjustments when set to dispense 0.14 ml of tuberculin at each firing.

With the jet gun set to dispense 0.14 ml of tuberculin at each firing, the nurses injected each woman on the flexor surface of her right forearm. At this time, they also used a disposable tuberculin syringe with needle to inject 0.1 ml of tuberculin into the most superficial layer of the skin of the woman's left forearm (Mantoux test). If the intradermal wheal produced by the jet gun or by the syringe and needle did not approximate 8 mm (7-9 mm) in longest diameter, the test was repeated at a distal site. (Jet-injected tuberculin tests had to be repeated less frequently than syringe and needle-injected tuberculin tests). Two to 4 days later, the nurses examined the test sites and used dividers and a ruler to measure responses to the nearest millimeters of induration.

Results

Thirty of the 522 women tested had responses that could be measured. The following tabulation shows that with syringe and needle (Mantoux) responses of 10 mm or more as the standard for a positive tuberculin skin test and responses of 5-9 mm as the standard for a doubtful tuberculin

test, the responses to jet-injected tuberculin were correct negative in 3 women, correct doubtful in 2, correct positive in 21, and false positive in 4. These four women with false positive responses to jet-injected tuberculin had syringe and needle (Mantoux) test responses in the doubtful, 5-9 mm, range.

Jet injector gun	Syringe and needle		
	Negative 1-4 mm	Doubtful 5-9 mm	Positive 10 mm
1-4 mm	3	0	0
5-9 mm	0	2	0
≥10 mm	0	4	21
Total women ..	3	6	21

The jet-injector technique frequently produced the larger response (fig. 1). The sample median for the jet-injected tuberculin test was 11.5 mm range $P(10 \text{ mm} < M < 16 \text{ mm}) = 0.9726$, and for the syringe and needle injected tuberculin test, it was 11 mm range $P(10 \text{ mm} < M < 14 \text{ mm}) = 0.9762$ (5).

Figure 2, a scatter diagram in which each woman's responses are plotted, shows that a significantly larger response to jet-injected tuberculin resulted in false positive jet-injector tests (≥ 10 mm) in four women whose Mantoux

Figure 1. Frequency distribution of reactions to PPD-tuberculin

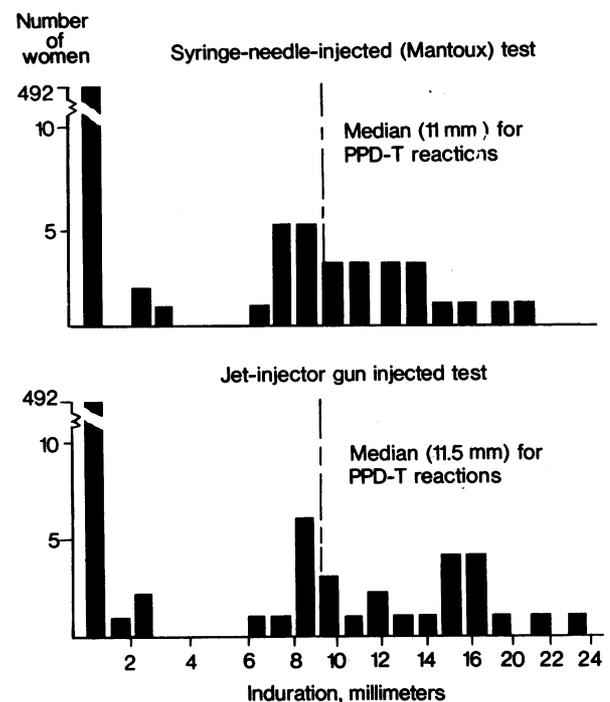
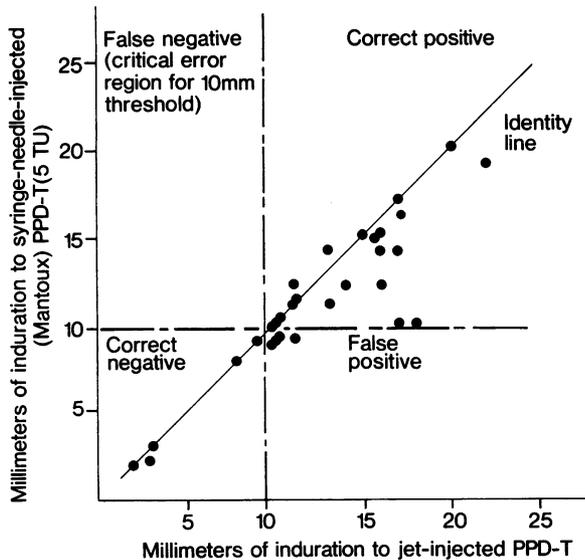


Figure 2. Reactions to jet-injected and syringe-needle-injected (Mantoux) tuberculin PPD-T in 30 pregnant women



tests were in doubtful (5–9 mm) range. According to present recommendations, these women should be queried about possible tuberculous contacts and, if necessary, retested to determine their tuberculin status. Figure 2 also shows that the standardized jet-injected technique of tuberculin skin testing did not lack sensitivity as compared with the Mantoux technique. There were no false negative responses to jet-injected tuberculin.

Discussion

The data seem to indicate that our method of standardizing the jet-injector gun method of tuberculin skin testing is practicable. Standardizing the jet injector test so that each test produced an intradermal wheal comparable in diameter with that of the Mantoux technique was not difficult. Once the jet-injector gun had been calibrated to dispense 0.14 ml of tuberculin at each firing, it consistently produced satisfactory wheals without further adjustments.

We also found that the standardized jet-injected tuberculin test did not lack sensitivity as compared with the Mantoux test. There were no false negative responses to jet-injected tuberculin in a sample population of 522 women who were tested with syringe and needle (Mantoux) and jet-injector techniques. Generally, the test results correlated well. On occasion, however, the jet-

injected tuberculin produced a significantly larger response. As a result, about one-sixth of the women with positive reactions (indurations of 10 mm or more) to jet-injected tuberculin had Mantoux responses in the doubtful range—5–9 mm. We concluded therefore that the standardized jet-injected tuberculin test had been reliable in detecting tuberculin sensitivity in the sample population, but it had not been reliable in differentiating between the women with doubtful and positive Mantoux reactions.

Summary

A technique was devised for standardizing the jet-injector gun method of tuberculin skin testing so that each jet-injected test produced an intradermal wheal comparable in diameter with that of the syringe and needle (Mantoux) tuberculin test. It was not difficult to standardize the jet-injected test. Once the jet-injector gun had been calibrated to dispense 0.14 ml of tuberculin at each firing, it consistently produced satisfactory wheals without further adjustments.

The standardized jet-injector gun method of tuberculin skin testing was as reliable as the Mantoux test in detecting tuberculin sensitivity in a sample population of 522 women. But the standardized jet-injected test was not reliable in differentiating between the women with doubtful and positive Mantoux reactions.

REFERENCES

- (1) Feigenbaum, E., Cherney, A., Spradlin, E., and Fry, A.: Comparing Mantoux and jet-injection methods of tuberculin skin testing. *Public Health Rep* 83: 974–979, November 1968.
- (2) Luby, J. P., Kaiser, R. L., Herring, L. L., and Dull, H. B.: Jet injector tuberculin skin testing: a comparative evaluation. *Am Rev Resp Dis* 97: 46–53 (1968).
- (3) Dull, H. B., et al.: Jet injector tuberculin skin testing: a comparative evaluation. *Am Rev Resp Dis* 97: 38–45 (1968).
- (4) Bailey, W. C., Thompson, D. H., and Greenberg, H. B.: Indigent pregnant women of New Orleans require tuberculosis control measures. *Health Serv Rep* 87: 737–742, October 1972.
- (5) Campbell, R. C.: *Statistics for biologists*. Ed. 1. Cambridge University Press, Great Britain, 1967, p. 34.

EQUIPMENT REFERENCE

- (A) Ped-O-Jet Injection Apparatus, Scientific Equipment Manufacturing Corp., 99 Dell Glen Ave., Lodi, N.J. 07644.